Can Policy Be Risk-Based? The Cultural Theory of Risk and the Case of Livestock Disease Containment

Dominic Duckett,* Brian Wynne, Rob M. Christley, A. Louise Heathwaite, Maggie Mort, Zoe Austin, Jonathan M. Wastling, Sophia M. Latham, Ruth Alcock and Philip Haygarth

Abstract

This article explores the nature of calls for risk-based policy present in expert discourse from a cultural theory perspective. Semi-structured interviews with professionals engaged in the research and management of livestock disease control provide the data for a reading proposing that the real basis of policy relating to socio-technical hazards is deeply political and cannot be purified through 'escape routes' to objectivity. Scientists and risk managers are shown calling, on the one hand, for risk-based policy approaches while on the other acknowledging a range of policy drivers outside the scope of conventional quantitative risk analysis including group interests, eventualities such as outbreaks, historical antecedents, emergent scientific advances and other contingencies. Calls for risk-based policy are presented, following cultural theory, as ideals connected to a reductionist epistemology and serving particular professional interests over others rather than as realistic proposals for a paradigm shift.

Introduction

The cultural theory of risk (or cultural theory) argues that we should be thankful for a society in which the discourse on risk is highly politicised because this demonstrates a healthy, free debate on values (Douglas 1992a). Quests for depoliticised, objective footings on which to found conceptions of risk, Douglas continues, neglect the profound significance of culture yet appeal to experts seeking to escape the messy, contested realities of the social world by bracketing them off in the quest for less troublesome probabilistic approaches. Following Durkheim, Douglas (1992a) argues that any comprehensive theory of social action must face up

The copyright line for this article was changed on 24 July 2015 after original online publication.

Sociologia Ruralis, Vol 55, Number 4, October 2015 DOI: 10.1111/soru.12064

to the centrality of culture and in particular account for group representations. This article attempts to explore these arguments in the context of livestock disease risk management, a domain in which calls for risk-based policy are persistent, as we will show, and appear to represent precisely the sort of ill-founded escapism Douglas (1992a) seeks to challenge. This article considers the function of the calls for more risk-based policy in the rhetoric of a particular group of experts and attempts to account for it with concepts from the cultural theory of risk.

Livestock disease risk is a context that has been increasingly prominent on the socio-political agenda in recent years. The UK, in particular, has experienced severe effects from livestock disease, most notably through the bovine spongiform encephalopathy (BSE) crisis that emerged in the mid-1980s, and the foot and mouth disease (FMD) outbreak of 2001. More recently, highly pathogenic avian influenza (HPAI) has refocused interest worldwide on the risks and uncertainties connected to the human-animal interface. This high-profile animal disease management context provides a space in which long-standing and seemingly incompatible views on the interactions between risk and society can be debated.

The paradigm critiqued in this article and one prominent in positivist epistemology is the view that public policy toward uncertainty ought to be foundationally informed by objective, scientific and technical risk assessment rather than being a hostage to fortune through politics or irrational public responses (Burnstein 1996). Risk professionals and technical experts often articulate this idea through calls for risk-based policy, arguing that better outcomes can be effected by a rational, quantitative mechanism, able to set policy on a neutral, objective footing, unpolluted by messy, socio-political distractions. Objective risk assessment, according to this worldview, ought to provide a foil to common, destabilising, political vagaries by grounding policy in untainted, neutral, formal risk assessment. Quantitative risk analysis is an established discipline that appears well placed to overcome this messiness by differentiating incalculable uncertainty from calculable risk measured through probabilities (for example Vose 2008). In relation to disease containment, risk modelling and epidemiology are disciplines strongly associated with the risk-based rhetoric explored below.

What distinguishes a risk-based approach from other approaches is essentially a systematic attempt to assign more resources to those factors likely to have greater effect if the risk event occurs. The rationale of risk-based policy has been summarised in the epithet 'worst things first' (Finkel 1994). For epidemiological hazards, a particular pathway may be assessed to be more significant in transmitting an infectious agent or predisposing to disease (either actually or potentially) and therefore may warrant more control, surveillance, eradication, or some other intervention. With BSE, for example, particular beef cuts were removed from the human food chain because the risk assessment determined that they were more likely to cause human cases of Creutzfeldt-Jakob disease. Here, the risk-based approach strives to offer an objective approach grounded in probabilistic calculation to support decision-making.

The rationale of the risk-based approach has been persuasive; throughout the 1970s and 1980s it was highly influential in environmental policy thinking. Philosophically, it has its origins in Cartesian analysis and in the empirical, utilitarian approaches of Bentham and Mill (Rosa 2000). Central to the reductionist logic is the idea that the

benefit upon which the actuarial, or probabilistic analysis hinges, is uncontested (Busby and Duckett 2012; Duckett and Busby 2013). It may appear uncontentious, for example, that a maximum return on investment is the overriding objective for a fund manager, provided statutory legal obligations are fulfilled, although, even in this case, ethical considerations may interrupt the narrow economic logic of social benefit. Socio-environmental hazards, including animal diseases, tend to be much more complex cases, often with incommensurable containment objectives.

A quantitative approach capable of overcoming the complexity of social benefit has long been a goal of risk theorists beginning with Starr (1969) yet has remained elusive (Douglas 1992a). This was starkly evident during the UK FMD outbreak in 2001 when benefits for some actors in the British beef trade clashed with a host of other social concerns in a crisis that has been extensively studied (for example, Woods 2004; Mort *et al.* 2005). In direct challenge to the reductionist paradigm of risk-based approaches, subjectivist social theories of risk have emerged, with proponents arguing that risk assessment is itself an inescapably political process. Quantitative risk analysis, it is argued, is no more value-free than other overtly political processes. In particular, cultural theory (for example, Douglas and Wildavsky 1982; Dake 1992; Thompson 2008) proposes that the application of quantitative risk analysis to matters of social concern as though it were a neutral, objective process is epistemologically misconceived, particularly in relation to technological fixes. The selection and application of science, technology, and indeed of any putative knowledge, is loaded with a tendency to support one set of interests over others (Latour and Woolgar 1986; Law 1991; Wynne 2008; Shortall 2013). The fundamental idea behind the critique of a neutral calculus of risk (Beck 1992) is that while quantitative risk analysis is extremely powerful when properly directed, it is not an appropriate tool for grounding socio-economic and socio-political decisions over complex social issues that have contested and incommensurate dimensions. Probabilistic approaches are singularly effective in reducing uncertainty, the critics concede, in tackling some well-structured problems, for example, in engineering (Wynne 1992) or gambling (Douglas 1986). However, in relation to environmental hazards, where issues of the highest order of complexity are to be found, probabilistic approaches are not sufficiently comprehensive mechanisms to underpin complex choices on social organisation (Douglas 1992a). Far from accepting the probabilistic risk-based approach as the best guarantor of objectivity, shielding society from the more irrational effects of interest-based politics, Douglas challenges the very legitimacy of 'escape routes to objectivity' (Douglas 1992a, p. 11), arguing that risk policy is rarely constructed on the basis of calculating numbers. Moreover, it is only within a political and cultural context, allowing for particular forms of social organisation, norms, roles, interests and contingencies that social behaviour in response to risk can be properly understood (Schwarz and Thompson 1990; Douglas 1992a, 1992b).

Others agree, labelling risk-based regulation 'a mirage' (MacGillivray *et al.* 2011) and identifying within dominant probabilistic risk discourse a subversive scientism that acts to make other socially useful understandings invisible (Wynne 1992). The apparent straightforwardness of assigning resources to risks, when applied to environmental issues, is, in practice, always highly politicised according to the critics. Competing claims for prioritisation that attempt to weigh different sorts of harms,

such as the welfare of animals against economic interests, do not ideally lend themselves to probabilistic analysis (Commoner 1994). The result, according to Douglas (1992a) is that throughout the actual process of policy formation for tackling risk, probabilistic conceptions are held at arm's length. Douglas (1992a) argues that, rather than being invoked at the inception of policy, as a risk-based policy implies, a peripheral deployment of quantitative risk analysis is both evident in practice and desirable for democratic societies. As Winston Churchill is reported to have said, scientific advisors should be 'on tap not on top'.

In contradistinction to this marginalisation of 'risk as probability' in policy debate, within the discourse of risk analysis, Douglas claims that the very opposite marginalisation comes to the fore:

> When I tried to engage established risk analysts in conversation I soon gathered that to emphasize these dubious uses of risk is perverse, a dirty way of talking about a clean scientific subject. Though they recognize that the grime and heat of politics are involved in the subject of risk, they sedulously bracket them off. Their professional objective is to get at the real essence of risk perception before it is polluted by interests and ideology. (Douglas 1992a, p. 11)

In light of these anecdotal observations from Douglas about the way quantitative risk and politics are in practice typically and understandably disconnected, this article examines expert discourse in which calls for risk-based policy are clearly articulated. In short, despite significant critical work detailing challenges that seem to require the conventional political footing upon which policy rests (Kasperson *et al.* 1988; Renn *et al.* 1992; Slovic 2000) rather than risk-based policy, strong rhetorical calls for the latter approach persist. What makes this a matter of grave concern, critics claim, is that the calls for change originate from self-styled peaceful centres of progress and rationality (Beck 1992) often masking other important dimensions (Wynne 1992).

A rural economy and land use program (RELU) project under the title Lost in Translation (Austin *et al.* 2012b), from which the data set explored in this article has been drawn, set out to improve the efficacy of knowledge exchange in the animal disease context. Three particular animal diseases encompassing some of the diversity that make this area particularly challenging from a socio-technical standpoint were targeted by the project and will be briefly summarised in the next section. The basic premise, reflected in the project's title, is that there are boundaries between, and perhaps to a lesser extent within, different groups of social actors that result in communication failures and lack of mutual understanding. These failures are detrimental to effective disease-control strategies. Through interviews conducted in this project we examine the discourse of risk-based policy with the wider goal of helping to facilitate better policy decisions.

Our analysis proceeds by first identifying persistent calls for risk-based policy in the discourse. We then attempt to empirically demonstrate Douglas's contention (1992a) that probabilistic risk approaches, including quantitative risk analysis, are at best peripheral or (in her words) 'arm's length' policy drivers. We show this by identifying other types of risk construction present in the data which, we argue, are more central in practice and are important in a democratic society. The empirical evidence we draw upon is not policy itself but the discourse (captured through

qualitative interviews) of influential actors who are closely connected with risk management for livestock diseases and who inform policy. It is worth noting here that other studies have looked directly at the policy level, for example:

> Interestingly, the term 'probability' has not been mentioned in the WFD *[the EU Water framework Directive],* the guidance documents or the expert interviews. (Sigel *et al.* 2010, p. 505)

Our article then turns, in the discussion, following Douglas (1992a), to accounting for both the absence of probabilistic terminology and the presence of more overtly political elements which, we argue, are general and necessary features of policy development. Furthermore, we attempt to illustrate, through a cultural theory reading of the data, that persistent calls for risk-based policy have a rhetorical function that acts to promote the professional group interests of those making them; actors who are, by and large, shown to be fully aware that they are necessarily engaged in the 'heat and grime' of politics. An elaboration of this reading is continued in the conclusion, where more general significance is claimed for the study, which we believe is representative of professional practice in relation to other socio-technical hazards

Three animal diseases illustrative of containment policy challenges

Different diseases exemplify particular risks and uncertainties. For example, distinct pathways exist for different diseases; varying scales of impact affect their socioeconomic trajectories and different configurations of animal/human relationships bring with them particular challenges for disease containment. The three diseases outlined below were chosen to allow a broad insight into these layered complexities.

Cryptosporidiosis is a water-borne zoonotic disease (that is, one that is naturally transmitted between vertebrate animals and humans). Outbreaks in human populations are typically connected with contaminated drinking water. Symptoms include abdominal cramping and diarrhoea. Water contamination is usually caused by infected faecal matter from animal hosts. In the UK the problem is commonly associated with the proximity of farm animals to drinking water catchments. The problem has particular management issues in the context of the privatised for-profit water industry operating in the UK (excluding Scotland) post-deregulation. The zoonotic dimension involves issues of public health that are absent in many animal diseases.

Foot and Mouth Disease (FMD) is an infectious viral disease that affects cloven-hoofed animals. It does not infect humans but the presence of the disease has profound social and economic implications. The UK has historically followed a strict policy of culling infected and contiguous herds. The widely dispersed outbreak in the UK in 2001 was the world's worst in a previously FMD-free country and was marked with media images showing burning pyres of culled livestock. Animal movement restrictions were enforced and additional biosecurity practices frequently had the effect of isolating rural communities in their homes and farms, causing children to miss up to 6 months of schooling and stopping recreational activity in many countryside areas (Convery *et al.* 2005). The net effects of the epidemic included significant reductions in rural tourism in many areas of Britain (Scott *et al.* 2004).

Highly Pathogenic Avian Influenza (HPAI) has the potential to cause global pandemic (Oxford 2005). A previous genotype of avian flu in 1918 killed millions of people around the globe (Kolata 2000). Like other viral diseases it has the potential to mutate into novel forms for which human populations have limited immunity, and for which treatments and preventive medicines may take time to develop and distribute. In the UK, 2007 was marked by outbreaks of the dangerous H5N1 variant of avian flu in Holton, Sussex and Diss, Norfolk and led to the culling of commercial poultry accompanied by worldwide media attention (Martin *et al.* 2006).

More broadly, the containment of animal disease exemplifies narratives that are constructed around risk by professionals involved in managing socio-technical risks. Management outcomes often appear inherently intractable where technological solutions are emergent and scientific understanding is incomplete, giving prominence to restricted, defined uncertainties whilst obscuring other understandings (Wynne 1992).

Interviews with stakeholders: some notes on method

The RELU project, of which the present research formed a part, provided a rich data set of semi-structured interview transcripts from a programme systematically designed to engage a range of participants from policy-level actors to scientists working in laboratories and to industry insiders, all charged with responsibility for risk management and disease containment. The composition of the stakeholder group was designed to cut across policy scales, incorporating people at operational, tactical and strategic levels (Fish *et al.* 2011). In total 54 individual and small group stakeholder interviews were conducted. The interviews explored important emerging cross-disease themes, encompassing issues such as biosecurity, trade and communication. The interviewees considered disease management in the context of their own roles and experiences with respect to the three diseases outlined above (Austin *et al.* 2012a).

This article examines the calls for risk-based policy in the data set and shows how these particular rhetorical elements coexist with the more nuanced understandings of risk also present in our data. Sociological challenges to the risk-based policy paradigm are then developed, guided by insights from cultural theory.

The central issue put to the contributors during semi-structured interviews, focus groups and workshops concerned scientific uncertainty and its incorporation in policy development. The rationale for the project was that strategies of animal disease containment face considerable socio-technological challenges that could potentially benefit from an examination of often overlooked uncertainties.

That the general public or the popular media, when thinking about hazards, do not begin with quantification or other elements of formal risk analysis is perhaps trivial. The analysis presented here supports a more nuanced claim and one that has a strong tradition in sociology, that even people well-versed in scientific methodologies, familiar with the latest research in their field and calling for risk-based policy themselves in many instances (as shown in excerpts below), are, in practice, constructing their risk facts in the same kinds of non-probabilistic and political terms as the general population (see Latour and Woolgar 1986) or as diverse cultures (Douglas 1992a). This is particularly pertinent given that some theorists have argued that

experts and lay people are at opposite ends of a spectrum in matters of risk analysis; the former operating within a probabilistic paradigm, and the latter navigating their world with the aid of less precise instruments or on gut instinct (Slovic 1987; Jensen *et al*. 2005). This popular distinction is challenged in this article where our data show that the contributors, who were ably qualified to discuss the problems of animal disease containment in terms of probabilities and quantifiable impacts given their expert credentials, were also quite at home constructing a risk discourse consistent with cultural theory. An analysis of the transcripts is presented below.

Two significant assumptions underlie the analysis. The first is that the situations explored here are indicative of more general patterns of concept foundation and that individual performances are open to a wider interpretation as symbolic actions in the context of other performances. The meanings of words without reference to this context become, largely, empty speculations. Indeed, content analysis is founded on the idea that discourse in all its forms can reveal something about the way people think (Krippendorff 2013).

The second assumption is that findings drawn from the analysis are not artefacts of the research methodology, owing their existence to the conscious imposition by researchers. Interrogation of the data for evidence of the characteristics that Douglas (1992a) describes was not a factor in the design or execution of the data-gathering exercise, which was carried out by other researchers with a quite separate research agenda in what was a wide-ranging project (Austin *et al*. 2012b). An adventitious opportunity to subject the data set to such analysis arose after the fact, independently from any explicit interest in cultural theory. This is not to say that the researchers who gathered the data were free from bias and we accept that under different circumstances another data set might offer less support to the conclusions drawn here.

The article proceeds by first presenting excerpts from the data with interpretations illustrating the tensions between probability risk assessment and policy development. The contributors are shown to call for risk-based policy development. They are further shown in subsequent excerpts, sometimes paradoxically, exhibiting strong sympathies for more conventional political approaches.

Contributors' calling for risk-based policy

Calls for risk-based policy in the data appeared in the form of criticisms of policies perceived as reactive. Typically, outbreak events were said to precede unplanned and disproportionate policy responses instead of apolitical, measured approaches. Individual formulations differed in detail but adhered to this general shape consistent with Douglas' observation that clean or untainted risk-based policy exists as a hypothetical alternative to polluted or flawed politically driven policy (Douglas 1992a).

In this first excerpt, policymakers were alleged to have shifted their attention from one issue to another as a result of the H1N1 swine flu outbreak of 2009:

> You know, if you look at policymakers in Defra and Drinking Water Inspectorate and the Scottish Government, they're busy people, they're driven politically. I mean, we've been trying to do or complete some work on looking at water treatment interventions – and we've been looking at that in a series of immunological surveys, which has lasted three years and the difficulty has been right now the intervention of H1N1 on policy that they have to

> undertake just to make sure, and so, whatever the greater perceived risk, and I think that's a political rather than a clinical risk.

The excerpt contains a contradistinction in which rational process, marked by rigorous scientific method, here 'a series of immunological surveys' is interrupted by an immediate change, 'right now' caused by an outbreak that redefines risk *politically* rather than *clinically*. This exemplifies a generic shape, identified throughout the transcripts, where a preferable risk-based or evidenced-based *modus operandi* (in this example, the completion of years of work ascertaining 'clinical risk') is said to be put into jeopardy by a political approach. The speaker here partly excuses policymakers on the grounds that they are busy, but this allowance does not extend to endorsing the political turn of events.

A second opinion echoed this logic:

> So there are things we know that we can – that would work that we're unable to apply because of public, or honestly, I think, political qualms. My [laughs] experience of evidence-based policy is that where science and politics meet, politics always wins.

Here again, valuable knowledge is juxtaposed to politics. There is an epistemological idealisation of a scientific approach to risk; 'things ... that we know that would work', by which it is implied that the issue at hand would be controlled more effectively, indeed; may never have arisen had the reductionist paradigm been foundational. Similar notions are championed repeatedly by the interviewees, who hold their solution (risk-based or variously evidence-based policy) to be an alternative preferred to policy predicated on political considerations, pejoratively labelled 'qualms'. Critics have interpreted such expressed preferences as misguided aspirations for the 'domestication' of risk (Wynne 1992).

Simply put, risk-based policy is widely understood as aspiring to address 'the worst the most' or, in other words, ensuring a logically identified, more serious issue receives more resources than a less serious one (see Finkel 1994). This notion was echoed throughout the data, in a way reminiscent of a mission statement:

> So you should focus most on the risk. And in fact the DWI [Drinking Water Inspectorate] – the regulations in 1999 were risk-based, because you did a risk assessment, and it was only those sites that failed the risk assessment that had to do the continuous monitoring.

Instead of this idealised risk-based approach, represented as an unmitigated success when adopted, the policy is said to be compromised by being event-driven which, in the current disease context, typically involves being reactive to outbreaks:

> And the difficulty that you have is that it's actually quite hard to, in most cases, get people to really focus and put the resources into these areas until it's a real incident.

An apparent premise, and one that requires careful examination, is that response to risk is frequently misdirected in respect of the prioritisation of hazards due to a lack of risk-based policy. This view received repeated rhetorical support in the data, often with explicit normative characteristics: '*We ought to be focused most on risk*', according to a participating risk analyst. It is as though there were a moral imperative of risk. A

rational society, contributors argued, *ought* to act on the basis of proper quantitative risk assessment and not leave policy to the mercy of incidental circumstances:

> ... it's not the absolute, as it were, measure of the importance of the policy, it's the political influence that changes and then the policy changes as a result ... sometimes almost incidentally, somebody comes up with a real, you know, a new drug or a strategy of some sort that will combat one of those low grade diseases and you do get a real initiative. Or alternatively, it's a disease that becomes so important to industry because of its economic impact that industry itself actually, you know, gets its act together and does something about it. *But these are the sort of* listings [prioritising diseases logically] *that in a way we should be doing all the time*. [Our emphasis]

The preceding excerpt exemplifies another tension that was repeatedly identified in the data. Circumstantial drivers are broadly accepted as efficacious, leading to 'real initiatives' or 'something being done', but they are also criticised as unsystematic. Rather the speaker bemoans the lack of absolute measures from which priorities can always be set without the necessity of chance innovation through a new drug or the escalating financial impact of a disease. This excerpt typifies a repeated idealised commitment to an approach transcending politics that was incongruously set against insights acknowledging that reactive approaches were successful. An analysis of the transcripts showed that the contributors not only had sophisticated understandings of the constraints under which policy operates, but that they were frequently strongly supportive of politically based policy outcomes. Working within a complex social milieu, the participants unsurprisingly appreciated political realities; however, this recognition of politics exceeded a grudging acknowledgement of serendipity and respondents frequently supported politically driven outcomes that were at odds with their commitments to risk-based approaches. Several comments acknowledged that there was a de facto circumstantial dimension, sometimes historical, sometimes newly emergent. These included reflective comments on the uncertainties of disease containment that were grounded in detailed appreciations of political circumstances that led contributors to paradoxical conclusions about the relationship between idealised risk-based policy and actual 'warts and all' policy:

> So with cryptosporidium there was the very large outbreaks in Hull and Oxford, and the fact that they'd occurred meant that there was a government response ... And so as a result of that, over the years things have been done to improve the situation. It's not necessarily the same in the rest of Europe. So if you don't have the routine surveillance, which we do, then you won't pick up the outbreaks. And therefore you won't have the political incentive to do something. So it's kind of a chicken and egg – you know.

This recognition that outbreaks can drive measures that ultimately feed back into improvements was repeated among the contributors on all three disease issues focused on in the analysis:

> ... it's all dependant on the outbreaks. So if you don't have outbreaks – you know – there's no pressure from the public to sort things out.

These contradistinctions, held at times in parallel by the same contributor, showed the participants' awareness of an inherent paradox in their statements over risk and uncertainty. Outbreaks were often seen as essential, if not necessarily ideal drivers of policy.

The chicken and egg metaphor introduced by several participants is a feature of particular interest. It seems to be paradoxical to the interviewees precisely because they find it difficult to envisage effective risk-based policy existing prior to the political pressures already being in place (typically generated by outbreaks) and yet this is their explicit goal in calling for risk-based policy.

In a variation of the paradox an expert from a veterinary laboratory describes attempts to model risk at an early stage before sufficient data was available to undertake effective analysis:

> We introduced risk analysis into crypto far too early. We could have, should have saved our money, done research on it and then – But, chicken, egg, I mean, we didn't realise it was so crap until we did it, but it was really trendy at the time and even Defra wanted it in there.

The data also included recognitions of wider, overriding structural conditions that constrain and shape animal disease-containment policies:

> ... the world is, of course, split, you know ... between the FMD free and the FMD endemic. The FMD free have lots of resources, lots of tools and lots of fancy gizmos. The FMD endemic have no money, no resource and ... lots of FMD.

In the face of global challenges of this scale, quantitative risk analysis plays an essential role but contributors concurrently held other drivers to be foundational in the development of policy, for example, powerful actors with financial muscle, technological innovation, and the unpredictable occurrence of disease outbreaks that serve to galvanise networks of support.

What we aim to have established from the analysis is that rhetorical calls for risk-based policy are tempered, even by those making them, by a recognition that there are other powerful contenders for the position of policy base. That outbreaks, or other circumstances, rather than probabilistic risk analysis, shape public policy would be, to many readers, unsurprising. When asked what might derail the politician apparently set fair, a wily campaigner (allegedly Harold Macmillan) is apocryphally said to have remarked 'events, dear boy!' In other words, there is a constant stream of what Galbraith (1977) refers to as 'the tyranny of circumstances' that will often determine the political course, regardless of well-intentioned efforts to use risk tools to plan sensible strategies.

The pursuit of professional interests

The theme 'grant or funding' is a familiar concern to most researchers, the current authors being no exception, and a certain meeting of minds between researchers and interviewees may have emphasised the theme to some extent. Nevertheless, the prominence of the funding theme, woven into accounts of animal disease containment risks and uncertainties by this mixed group of scientists, veterinarians and risk managers, demands a theoretical explanation.

In part the participants enrolled in the research may have simply picked up on the uncertainty theme and translated it into the uncertainties of their professional lives, taking the opportunity in conversation to share their frustrations and reflections about the difficult fiscal environment in which they operate. Further than this,

however, we argue that the constraints imposed by discretionary funding act to shape outcomes that have a real bearing on disease containment. One dimension of this shaping seemed to become evident early in several interviews, as participants explained how they had come to occupy their current role or embark upon the career paths that had led them there. The contributors explained how the availability of funding had influenced research topics and partly steered them in certain directions. This driver, in their view, often had little to do with risk, for example:

> If you see the money that goes into toxoplasma, it is a big, big item within that field and they get a fair amount of research funding and yet it is not a particularly important infection. Although the consequences can be devastating it is relatively rare.... You know if you make an interesting case for addressing a biological question and that is usually good enough ... It's more a biological interest that is driving it. We have to package it as a public health thing because that is how we get the money but my own interest is really more a biological interest in these organisms.

This plausible account of idiosyncratic drivers of disease research was echoed elsewhere in the data:

> A lot of the research is driven by, you know intellectual curiosity and interest in some biological questions, which I think is fine but you know I have some doubts about the relevance of that to control [of animal disease].

The point here is that the process by which a particular disease is selected for scientific research is not itself on the basis of 'most research for worst hazard'. Researchers select their objects of study on the basis of their own personal histories in much the same way as other people choose careers. Once it has been selected, the researcher is invested in the particular object of study and is in competition with other researchers promoting rival studies:

> ... the scientist has that double identity because the scientist is simultaneously, in an academic context, you're trying to draw down funds; they're working simultaneously say in a fundamental experimental science context and then also being the salesman. They get on a train to London and they presumably try to sell. There's almost like a double identity isn't there?

In this excerpt a scientist describes how the competition for funding resources incentivises the competitors to represent their chosen hazard as the worst. This insight illustrates how the background of disease control, even at the level of fundamental scientific research, is partly founded upon group interest. Practice regularly appears overtly political, with parties acknowledging that they are packaging their assessments in order to attract funding. At the same time much valuable quantitative risk analysis is doubtlessly being conducted; data are being rigorously gathered; comparisons between hazards are being made; risk analysis is being assiduously undertaken. All the afore-mentioned have an important role in the design of policy. This much is not in dispute. Our challenge is to the notion of a risk-based policy. This study reveals that, according to the protagonists themselves, even the most fundamental drivers of research and of risk management activities in general are not conceived in an apolitical vacuum, but are born out of group interests and enmeshed

in competition for resources. When it comes to foundational development of policy, those actively involved in conducting risk analysis and managing risk at all levels, are clearly involved in political negotiation about how seriously their particular risk ought to be taken. From a cultural theory perspective this is not a pejorative observation. The worst is not an absolute scientific matter but always a partly normative judgement assembled in a cultural, socioeconomic, political and uncertain world.

Acknowledging this brings us to the crux of the matter. The rationale of aspiring to a risk-based policy, as an end that resists political vagaries and sets policy on an objective footing, logically makes two erroneous assumptions: firstly that the worst is an objective rather than a normative consideration suited to probabilistic approaches; and secondly that it is possible to separate objective scientific endeavour from broader political realities in complex socio-technical situations. Both these assumptions are challenged in the disease-containment scenarios in which the actors interviewed in this article are engaged.

Group interests led to variations in the competition theme. In the following excerpt a scientist describes the requirement for a policy decision to operate in the face of scientific indeterminacy:

> So I don't question that modellers are useful,... but what would happen if in 2007 the modellers said, 'We have to vaccinate' and the veterinary advice was, 'We don't have to vaccinate'?... Who's going to make a decision on that?

Other comments revealed instances where risk analysts were held, by our expert interviewees, to be ignorant of political exigencies. Contributors whose senior roles had drawn them into the policymaking web alleged that laboratory-bound colleagues had an ivory tower naivety. A veterinary scientist viewed mathematical modellers as lacking hands-on disease experience. Other comments stopped short of attributing blame to specific actors but rather drew attention to indeterminacies that could have major influence.

The next example concerns a policy to cull rather than to vaccinate in response to FMD:

> I know in 2001, I think it was 18 months before Japan would buy beef from the UK again, not the six months that was stipulated by OIE [World Organisation for Animal Health] at the time. Once you lose your footing in the market, somebody else will get in there ... it wouldn't just be a question of, 'Oh, you know, OIE says we're okay, we can trade again,' you've lost those partners and those links because somebody else is selling it to them. Brazil's selling it to them cheaper or something.... So you've got those economic aspects that are very difficult to pin down in monetary terms ...

The trade implications in the preceding excerpt are characterised in terms of fiscal uncertainty. The contributor allows that policy needs to be adaptive to market effects that often resist quantification.

The preceding extracts from a large data set have shown a tension between calls for a foundational shift in approach and an appreciation of the rationale behind the current, more holistic approach. The article next turns to a consideration of the reason for this tension.

Discussion

This article identifies a rhetorical commitment to risk-based policy among a group of actors influential in the construction of animal disease-containment policy. Furthermore, it shows that participants express awareness consistent with Douglas' claim that the risk thinking that is central to policy debates is frequently divorced from probability calculations (Douglas 1992a). But our objective is not simply to observe that the social construction of risk is necessarily wider than quantitative risk analysis. What our analysis shows is that as they socially construct risk, our contributors entertain paradoxical positions; on the one hand aspirational, commitments to risk-based policy, and on the other, explicit political awareness, acknowledging a more constrained role for quantitative risk analysis. The commitment to risk-based policy appears here to represent an alternative and ideal, fundamental starting point for policy, and the contributors who propose the paradigm of risk-based policy are precisely the sort of actors who might be expected to make such commitments. They are scientists, professional risk managers, mathematical risk modellers and other actors required to work with abstract risk and to feed knowledge into policy. Yet, simultaneously and crucially, the same actors often appear quite at one with the political dimensions of risk construction where risk-based considerations are clearly not foundational. Quite diverse opportunities or contingencies are often much more central. As Tschinkel argues:

> A good manager of an environmental agency needs to seize opportunities based on numerous factors other than risk. Political breakthroughs, statutory readiness, talent and inclination of leadership, availability of new technical information, and the degree of cooperation from sister agencies are some of these factors. The degree to which risk-based planning system discourages this kind of creative opportunism makes it less valuable. (Tschinkel 1994, p. 184)

The participants in our project variously recognised opportunities related to all of these numerous factors. They talked about political opportunities resulting from deregulation in the water sector, European regulatory frameworks, technological innovation and networks of cooperation. Timing, benign circumstances and leadership, all either contributed to or underpinned examples of disease control policy development. For example:

> ... one area is very dependent on industry support ... their interest is in modification of the immune response of animals at the level of the stem cell, and also in looking at transgenic disease resistant animals. So, the model there is influenza resistant poultry and the reason they've been able to get that project up and funded is because of the nature of the structure of the industry. Because it's so integrated and there's so few players at the very top end, it's the broiler industry I'm talking about, you know.... I mean, those guys do think, sort of, five, ten, fifteen, twenty years ahead and they can get their act together to actually help.

In the preceding excerpt the existence of a corporate market concentration is favourably represented as an enabling progress.

Risk-based approaches clearly have a role to play in policy directed towards complex social issues involving uncertainty, but the calls in our data to found policy

on probabilistic approaches to risk seem to be curiously inconsistent with the understandings of politics that the advocates of risk-based policy reveal through their acknowledgement that policy is almost inevitably reactive, and that when outbreaks of disease occur, particularly novel forms with a high degree of uncertainty over their epidemiology such as when H5N1 emerged around 2007, resources will be switched. At times the interviewees also appreciate the complexity of the constraints on policy with, for example, where trade considerations have to be weighed against animal welfare, or where issues of international justice arise as when the rich define controls for the poor, and a whole range of ethical and moral matters quite beyond the scope of conventional forms of risk analysis. Indeed, contributors conceded that risk-based approaches often seem more intelligible when placed further downstream, at the implementation rather than the strategy development phase. For example, the control of FMD in the national herd will be the result of a host of political considerations, coinciding in a coalition of forces in support of a control policy (see Latour 1988). An FMD-free status, like any policy, serves a variety of interests; including, as in this case, the livestock export industry, whose livelihood is at stake. After the strategic policy has been thrashed out in the normal heat and grime of politics with its horse-trading, coalition-building, populist pandering, and of course, all the more noble political elements: the altruism, idealism and fraternity by which people seek to improve the common lot; then the practical planning of measures can enter the phase where quantitative risk analysis is efficacious.

Detecting inconsistency in the logic of discourse is not remarkable, nor is it unusual to find a group of professionals who are aware of an intractable political universe in which effective policy has many potential drivers. Nevertheless, it is interesting from a sociological perspective to critique the widely held view that the narrow instrument of risk by which we mean a probabilistic, reductionist version of risk management (what Beck 1992, p. 6) calls, 'the calculus of risk [an innovation] making the incalculable calculable') should be promoted as a policy base. Against this we develop Douglas 's (1992a) claim that probabilistic risk is neither foundational in practice nor desirable as a foundation when it comes to making policy about socio-technical hazards.

From a cultural theory perspective, the emphasis on a narrow instrument of risk can be seen as reinforcing a boundary between the status of insiders and outsiders. It functions to allow a professional practice to be established in upstream decision-making and given pre-eminence. The justification for this approach proffered by participants stems from what they characterise as the fickleness of public opinion and the opportunity to marginalise this undesirable element from approaches to disease containment, thereby reducing dangers. But however apparently well-intentioned it is, the call for the elevation of the narrow instrument of risk is not neutral but acts as a cipher for more objectivity, more science, and more expert input into practices of risk management. These tacit meanings transform the term 'risk-based' into a metonym for science-led hazard management, a rhetoric all the more persuasive in current western epistemology where science exerts a strong claim to monopolise objectivity, and where any appeal to this provenance is difficult to gainsay. Policy towards serious hazards indeed requires properly resourced, science-led research and it is generally sensible to argue for more of it. The question as to

whether such a policy ought to be risk-based, however, is subtly but profoundly different and problematic. While aims to increase the scientific understanding of disease and to reduce the uncertainties that hamper disease mitigation are superficially uncontroversial as general policy directions, there are controversies (as our data show) over the detailed circumstances of disease outbreaks and what should be done about disease. Risk is ubiquitous but matters of epidemiological concern that rise to the top of the political agenda and demand action do not do so on the basis of probabilistic risk but because of the totality of their characteristics, including historical antecedents, perceptions of official mismanagement (Murphy-Lawless 2004), so-called dread (Slovic 1987) and, often, scientific uncertainty. These realities highlight dangers in heeding rhetorical pleas for risk-based policy in the potential framing of policy in ways that exclude other social understandings of disease containment, including competing scientific understandings (Wynne 2002). Underlying structures of belief can shape policy positions, often tacitly (Schön and Rein 1994, p. 23 in Nerlich 2004). In the case of animal disease containment, the advocacy of a risk based approach as an ideal foundation for policy correspondingly acts to demote the more democratic societal interests evident in political processes. The risk base paradigm implies that policy ought not to begin with democratic concerns but with a quantitative understanding of risk so as to minimise the impact of irrational misdirection through everyday politics. Cultural theory is alert to strategies that deploy a moral condemnation of the outside world by group insiders, pointing out that such strategies often serve to promote the lobbying group's interests (Douglas 1992a). As the evidence presented here shows, some of those advocating risk-based policy (our interviewees) at times openly acknowledge they are pursuing their personal and professional interests as they advocate that particular risks should be given greater resources or a higher priority than others. At other times motives may be concealed (for example, see Latour and Woolgar 1986). Scientists may lay claim to a special scientific methodology when defending their version of objective reality, yet any selection of purported facts and their deployment owes much to the interests of the groups selecting them, through what Latour and Woolgar refer to as the solidarity of their production, achieved through a system of accreditation in which all the actors are heavily invested. The extent of that investment leads experts to claim that the beliefs and economics that underpin their constructs are circumstantial and unrelated to the solidity of their claims. Hence, acknowledgements of vested interests vanish from accounts (Latour and Woolgar 1986). In other words, the explicit recognition of interests tends to be absent in official reports detailing the risk-construction process. The data presented here capture the reality of our contributors double-identity as, on the one hand, they make claims to an objective reality freed from the pollution of politics and yet on the other, when asked to reflect on the wider picture, they readily acknowledge they actively participate in the political universe in their processes of fact production. What may be missing from their official accounts, for example, their journal articles and reports or policy recommendations, was revealed discursively as the participants shared their concerns about funding. The specialists among them had selected to study the diseases that defined their careers without regard to risk probabilities but quite explicitly on the basis of what interested them the most. In pursuance of careers they packaged and represented their special

interest in the manner of salespeople (the word used by one participant) in order to obtain grants and funding. At the same time they called for more risk-based policy, not as a challenge to the political system in which many of them seemed entrenched, but as a symbolic gesture, making a claim for a transference of power and marking out territory.

Given that group self-interest is often pursued through cultural symbols, an idea central to cultural theory, it follows that calls for risk-based policy can be partly explained as a rhetorical request for more prestige and resources to be directed to the particular social group likely to benefit most. The various experts can be seen as capitalising on what they regard as negative elements of democratic society whereby it takes a crisis to get anything done or where public perception appears to range between risk attenuation and risk amplification (Kasperson *et al.* 1988). In other words, the function of the risk-based policy rhetoric is to encourage a degree of rebalancing in favour of techno-scientific management:

> Danger is defined to protect the public good and the incidence of blame is a by-product of arrangements for persuading fellow members to contribute to it. (Douglas 1992: 6)

In short, expert groups have varied motivations, including strong interests to control certain resources. Rather than wanting a foundational shift for policy, their choice of expression is often simply rhetorical – a political overture to package their claims for additional resources. In such cases cultural theory appears to offer a useful explanatory lens revealing that group projects that are furthered through symbolic forms.

However, the phenomenon of calls for more risk-based policy cuts across narrow group affiliations. The calls for governance, as currently practiced, to be placed on a significantly different footing clearly have broader support than merely risk professional insiders defending their corner. Latour (1988) explains that social transformations, in this case a proposed shift to a more technocratic approach to risk control, require broad-based support through the enrolment of groups with separate agendas. It has been proposed that a fundamental problem has emerged in society in relation to its policymaking, which Hajer (2003) has called the institutional void. Old certainties through which public officials were trusted to balance different policy requirements equitably have collapsed. The reason for this new landscape is that boundaries of sovereign polities have crisscrossed competing orders of authority existing as transnational and polycentric networks. Old levels of deference have declined. Where policy problems that demand political action occupy territory near to or across competing boundaries, authority is difficult to establish. Enticott and Frankin (2009) have identified precisely such problems in the containment of bovine tuberculosis and the associated uncertainties requiring political action in this space. Hajer's thesis might explain the generality of calls for risk-based policy that were encountered in the data. The absence of definitive authoritative underpinnings that has resulted in multiple levels of challenge to policy across society may act to promote risk analysis as a potential solution for dealing with the institutional void. But the prospect is anathema to Beck (1992), who sees the delegitimised technocratic regime of scientific-administrative expertise (see also Speck 2013) collapsing under reflexive modernity.

Douglas (1992a) is equally critical, viewing such calls as no more than arm waving towards fictitious escape routes.

Conclusion

The notion that policy ought to be founded upon probabilistic risk is, for cultural theory, misconceived. Risk itself is constructed. It serves to represent the relationships of people and things rather than being, in the conventional sense, a thing (Rayner 1988). Therefore, when policy is forged, as evidenced in the current context, it emerges intersubjectively. While probabilistic risk can certainly inform policy and may often need greater emphasis, it is, from a cultural theory perspective, neither what policy is based on nor what it ought to be based on. A quantitative assessment to determine 'which worst gets most' or 'goes first' in the complex context of animal health, and indeed all socio-technical hazards, for cultural theory, is not feasible. In democratic societies it is politics, with all its messiness, that is the only viable mechanism for the development of animal disease-containment policy, and calls for an alternative, purer risk-based approach, viewed through the cultural theory lens, are misconceived, exceeding what quantitative risk assessment is capable of. With the enormous complexity of different interests, from animal welfare to world poverty, the capacity of risk instruments to objectively determine priorities is and must remain severely limited. Quantitative risk analysis, its pretensions towards purity through a calculus of risk notwithstanding, is hugely important but it is subordinate to the social, intersubjective, inescapably political environment. The overwhelming presence of concrete reality necessarily precedes the abstraction of probabilistic risk in strict sequence and constitutes risk's foundation. Risk is always subordinate to and predicated upon the reality it seeks to explain. Of course, the relative cultural value of quantitative risk assessment as opposed to the political process is often rhetorically inverted with technical assessment frequently proposed as a more ideal starting-point. Reductionist belief in this ascendancy underpins calls for risk-based policy. The unpredictability, complexity, and for some, dangerous relativism of the political risk perspective understandably leads to a desire for the apparent surety of quantitative risk analysis to shore up otherwise fragile policy foundations; a prospect supported by actors staring into an institutional void. However, political realities will not bow to naive desires for a quieter, purer life. The peaceful centres of progress and rationality (Beck 1992) are mirages. Good policy needs to reconcile the best use of technical abstractions without reifying them and to come to terms with the reality of a competitive, multi-actor world that is continually frustrating and inherently uncertain. The experts we studied in the context of animal disease management recognise these challenges and openly acknowledge the necessity of exploiting the opportunities and avoiding the pitfalls of contingent reality. Calls for an alternative, risk-based approach, are better critically viewed as rhetorical pleas for more quantitative risk analysis, rather than a feasible proposal for a foundational shift.

Note

* Corresponding author.

References

Austin, Z., R.E. Alcock, R.M. Christley *et al.* (2012a) Policy, practice and decision making for zoonotic disease management: water and cryptosporidium. *Environment International* 40 pp. 70–78

Austin, Z., R. Christley, R. Fish *et al.* (2012b) Lost in translation: assessing knowledge sources, exchange and effectiveness in animal disease control. *Rural economy and land use programme policy and practice notes. Note 36* (Newcastle upon Tyne: Newcastle University)

Beck, U. (1992) *Risk society: towards a new modernity* (London: Sage)

Burnstein, P.L. (1996) *Against the gods: the remarkable story of risk* (New York: John Wiley)

Busby, J. and D. Duckett (2012) Social risk amplification as an attribution: the case of zoonotic disease outbreaks. *Journal of Risk Research* 15 (9) pp. 1049–1074

Commoner, B. (1994) Polution prevention: putting comparative risk assessment in its place. Pp. 203–228 in A.M. Finkel and D. Golding eds, *Worst things first?: the debate over risk-based national environmental priorities* (Washington, DC: Resources for the Future)

Convery, I., C. Bailey, M. Mort *et al.* (2005) Death in the wrong place? Emotional geographies of the UK 2001 foot and mouth disease epidemic. *Journal of Rural Studies* 21 (1) pp. 99–109

Dake, K. (1992) Myths of nature: culture and the social construction of risk. *Journal of Social Issues* 48 (4) pp. 21–37

Douglas, M. (1986) *Risk acceptability according to the social sciences* (London: Routledge & Kegan Paul)

Douglas, M. (1992a) *Risk and blame: essays in cultural theory* (London and New York: Routledge)

Douglas, M. (1992b) The self as risk taker: a cultural theory of contagion in relation to AIDS. Pp. 102–121 in M. Douglas ed. *Risk and blame: essays in cultural theory* (London and New York: Routledge)

Douglas, M. and A. Wildavsky (1982) *Risk and culture: an essay on the selection of technological and environmental dangers* (Berkeley, CA: University of California Press)

Duckett, D. and J. Busby (2013) Risk amplification as social attribution. *Risk Management* 15 pp. 132–153

Enticott, G. and A. Franklin (2009) biosecurity, expertise and the institutional void: the case of bovine tuberculosis. *Sociologia Ruralis* 49 (4) pp. 375–393

Finkel, A.M. (1994) Should we and can we reduce the worst risks first. Pp. 3–20 in A. M. Finkel and D. Golding eds, *Worst things first?: the debate over risk-based national environmental priorities* (Baltimore, MD: Johns Hopkins University Press)

Fish, R., Z. Austin, R. Christley *et al.* (2011) Uncertainties in the governance of animal disease: an interdisciplinary framework for analysis. *Philosophical Transactions of the Royal Society B: Biological Sciences* 366 (1573) pp. 2023–2034

Galbraith, J.K. (1977) *The age of uncertainty* (London: British Broadcasting Corporation and André Deutsch)

Hajer, M. (2003) Policy without polity? Policy analysis and the institutional void. *Policy Sciences* 36 (2) pp. 175–195

Jensen, K.K., J. Lassen, P. Robinson *et al.* (2005) Lay and expert perceptions of zoonotic risks: understanding conflicting perspectives in the light of moral theory. *International Journal of Food Microbiology* 99 (3) pp. 245–255

Kasperson, R.E., O. Renn, P. Slovic *et al.* (1988) The social amplification of risk: a conceptual framework. *Risk Analysis* 8 (2) pp. 177–187

Kolata, G.B. (2000) *Flu: the story of the great influenza pandemic of 1918 and the search for the virus that caused it* (Melbourne: Macmillan)

Krippendorff, K. (2013) *Content analysis: an introduction to its methodology* (Beverly Hills, CA: Sage)

Latour, B. (1988) *The pasteurization of France* (Cambridge, MA: Harvard University Press)

Latour, B. and S. Woolgar (1986) *Laboratory life: the construction of scientific facts* (Princeton, NJ: Princeton University Press)
Law, J. (1991) *A sociology of monsters: essays on power, technology, and domination* (London and New York: Routledge)
MacGillivray, B.H., R.E. Alcock and J. Busby (2011) Is risk-based regulation feasible? The case of polybrominated diphenyl ethers (PBDEs). *Risk Analysis* 31 (2) pp. 266–281
Martin, V., L. Sims, J. Lubroth *et al.* (2006) Epidemiology and ecology of highly pathogenic avian influenza with particular emphasis on South East Asia. *Developments in Biologicals* 124 pp. 23–36
Mort, M., I. Convery, J. Baxter *et al.* (2005) Psychosocial effects of the 2001 UK foot and mouth disease epidemic in a rural population: qualitative diary based study. *British Medical Journal* 331 (7527) p. 1234
Murphy-Lawless, J. (2004) The impact of BSE and FMD on ethics and democratic process. *Journal of Agricultural and Environmental Ethics* 17 (4–5) pp. 385–403
Nerlich, B. (2004) War on foot and mouth disease in the UK, 2001: towards a cultural understanding of agriculture. *Agriculture and Human Values* 21 (1) pp. 15–25
Oxford, J.S. (2005) Preparing for the first influenza pandemic of the 21st century. *The Lancet Infectious Diseases* 5 (3) pp. 129–131
Rayner, S. (1988) Muddling through metaphors to maturity: a commentary on Kasperson *et al.*, The social amplification of risk. *Risk Analysis* 8 (2) pp. 201–204
Renn, O., W.J. Burns, J.X. Kasperson *et al.* (1992) The social amplification of risk: theoretical foundations and empirical applications. *Journal of Social Issues* 48 (4) pp. 137–160
Rosa, E.A. (2000) Modern theories of society and the environment: the risk society. Pp. 73–103 in G. Spaargaren, A.P.J. Mol and F.H. Buttel eds *Environment and global modernity* (London: Sage)
Speck, S. (2013) Ulrich Beck's 'Reflecting faith': individualization, religion and the desecularization of reflexive modernity. *Sociology* 47 (1) pp. 157–172
Schwarz, M. and M. Thompson (1990) *Divided we stand: re-defining politics, technology and social choice* (Philadelphia, PA: University of Pennsylvania Press)
Scott, A., M. Christie and P. Midmore (2004) Impact of the 2001 foot-and-mouth disease outbreak in Britain: implications for rural studies. *Journal of Rural Studies* 20 (1) pp. 1–14
Shortall, S. (2013) Sociology, knowledge and evidence in rural policy making. *Sociologia Ruralis* 53 (3) pp. 265–271
Sigel, K., B. Klauer and C. Pahl-Wostl (2010) Conceptualising uncertainty in environmental decision-making: the example of the EU water framework directive. *Ecological Economics* 69 (3) pp. 502–510
Slovic, P. (1987) Perception of risk. *Science* 236 (4799) pp. 280–285
Slovic, P. (2000) *The perception of risk* (London and Sterling, VA: Earthscan)
Starr, C. (1969) Social benefit versus technological risk. *Science* 165 (3899) pp. 1232–1238
Thompson, M. (2008) *Organising and disorganising: a dynamic and non-linear theory of institutional emergence and its implications* (Axminster: Triarchy Press)
Tschinkel, V.J. (1994) State concerns in setting environmental priorities: is the risk-based paradigm the best we can do? Pp. 181–186 in A.M. Finkel and D. Golding eds, *Worst things first?: the debate over risk-based national environmental priorities* (Baltimore, MD: Johns Hopkins University Press)
Vose, D. (2008) *Risk analysis: a quantitative guide* (Hoboken, NJ and Chichester: Wiley)
Woods, A. (2004) Why slaughter? The cultural dimensions of Britain's foot and mouth disease control policy, 1892–2001. *Journal of Agricultural and Environmental Ethics* 17 (4/5) pp. 341–362
Wynne, B. (1992) Uncertainty and environmental learning: reconceiving science and policy in the preventive paradigm. *Global Environmental Change* 2 (2) pp. 111–127
Wynne, B. (2002) Risk and environment as legitimatory discourses of technology: reflexivity inside out? *Current Sociology* 50 (3) pp. 459–477

Wynne, B. (2008) Elephants in the rooms where publics encounter 'science'?: a response to Darrin Durant, 'Accounting for expertise: Wynne and the autonomy of the lay public'. *Public Understanding of Science* 17 (1) pp. 21–33

Dominic Duckett*
Social, Economic and Geographical Sciences
James Hutton Institute
Aberdeen AB15 8QH
UK
e-mail: dominic.duckett@hutton.ac.uk

Brian Wynne
Centre for Economic and Social Aspects of Genomics
Lancaster University
Lancaster
UK
e-mail: b.wynne@lancaster.ac.uk

Rob M. Christley
Institute of Infection and Global Health
University of Liverpool
Neston
Cheshire
UK
e-mail: robc@liverpool.ac.uk

A. Louise Heathwaite
Lancaster Environment Centre
Lancaster University
Lancaster
UK
e-mail: louise.heathwaite@lancaster.ac.uk

Maggie Mort
Department of Sociology and School of Medicine
Lancaster University
Lancaster
UK
e-mail: m.mort@lancaster.ac.uk

Zoe Austin
Environment Department
University of York
Heslington
York
UK
e-mail: zoe.austin@york.ac.uk

Jonathan M. Wastling
Departmentof Infection Biology
Institute of Infection and Global
HealthUniversity of Liverpool Liverpool
Science Park IC2
146 Brownlow Hill
Liverpool
UK
L3 5RF
e-mail: j.wastling@liverpool.ac.uk

Sophia M. Latham
Institute of Infection and Global Health
University of Liverpool
Neston
Cheshire
UK
e-mail: s.latham@liverpool.ac.uk

Ruth Alcock
Lancaster Environment Centre
Lancaster University
Lancaster
UK
e-mail: r.alcock@lancaster.ac.uk

Philip Haygarth
Lancaster Environment Centre
Lancaster University
Lancaster
UK
e-mail: p.haygarth@lancaster.ac.uk